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ABSTRACT

A study investigated the usefulness of instructional materials on the writing of scientific articles by comparing the descriptions of abstracts offered in the textbook with a sample of abstracts drawn from four fields of medicine (clinical medicine, surgery, epidemiology, basic sciences). The comparison was confined to abstracts of results-focused papers, and papers were divided evenly between British and North American journals. Analysis focused on discourse features in three areas: purpose; methods and results; and conclusion. Results indicate close similarities between the textbook and the abstracts, but also show the textbook to be overly simplistic and rigid. The relationship between information structure and linguistic elements was found to be more complex than was implied in the book. Specifications for sections introducing purpose ignore some frequent lexical signals; methods tend to be amalgamated into adjacent sections; and it is not always necessary to conclude with a generalization. While the analysis detected no systematic differences between abstracts in British and North American journals, some evidence was found that conventions vary according to field or type of research design. Contains 16 references. (Author/MSE)

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A GENRE ANALYSIS STUDY OF 80 MEDICAL ABSTRACTS

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A GENRE ANALYSIS STUDY OF 80 MEDICAL ABSTRACTS

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Abstract

ESP practitioners need to be confident that the genre descriptions we offer to our students enable them to exploit as fully as possible the range of rhetorical options characteristic of their particular disciplines. One of the most comprehensive genre-based pedagogical accounts of the scientific research article currently on the market is the popular Writing Up Research *(Weissberg and Buker, 1990). To determine how suitable this material would be for writers of abstracts in medical science, we compared the description of abstracts offered in the book with a sample of 80 abstracts drawn from 4 fields of medicine. We found that on the whole there was a match between the specifications and the abstracts, but that the textbook was overly rigid and simplistic. The relationship between information structure and linguistic elements is typically more complex than implied in the book. The specifications for sections introducing purpose ignore some very frequent lexical signals; methods tend to be amalgamated into adjacent sections; and it is not always necessary to conclude with a generalisation. While we detected no systematic differences between abstracts published in British and North American journals, we found some evidence that, even within medical science, conventions vary according to field or type of research design.*

1. Introduction

Genre analysis has proved a welcome resource in the design of EAP/ESP materials. Writing Up Research by Weissberg and Buker (1990) is an innovative and popular genre-based textbook, specifically focused on writing experimental research reports, but claiming to be applicable across a wide variety of disciplines. It contains one unit on writing abstracts. The unit presents an information structure model:

(B) Background (optional)

P Purpose

M Method

R Results

C Conclusion.

It also specifies typical linguistic signals, such as tenses, for the different parts of the abstract. The example texts are drawn from many fields but not, as it happens, medicine.

The other major recent publication in this area is Swales and Feak (1994). This book is also an EAP textbook for students from a wide variety of disciplines, but covers a wider range of text types than Weissberg and Buker. It contains two units on research papers, including a few pages on abstracts. Its treatment of abstracts is therefore less comprehensive, but, interestingly, the authors take a less prescriptive approach.

In spite of the importance of abstract writing in medicine, there are, so far as we are aware, no published course materials specifically for non-native writers of medical abstracts. The International Committee of Medical Journal Editors, however, has published specifications for writing research

reports (*Uniform Requirements for Manuscripts Submitted to Biomedical Journals*, 1993) which includes a paragraph on abstracts. The impressively detailed course book by Zeiger (1991), which contains 1 unit (26 pages) on writing abstracts, is for biomedical writers in general, not specifically nonnative writers. Zeiger is openly prescriptive. She is an experienced editor of biomedical papers and abstracts, and as such is a controller of the genre.

The genre analysis approach in applied linguistics is very different, being an almost ethnographic description of linguistic conventions in another (in this case medical research) community. Since Swales's analysis of research article introductions in 1981, there has been a flow of interesting studies of research writing. The focus of interest has been on the introduction (e.g. Swales 1990) and discussion (e.g. Hopkins and Dudley-Evans 1988) sections of the article, metalanguage (e.g. Mauranen 1993) and language choices in making citations (e.g. Oster 1981). For abstracts, the work most immediately relevant to the current study is by Salager-Meyer (1990a, 1990b).

Salager-Meyer (1990a) analysed 77 medical abstracts in order to establish the linguistic realisations of their moves. She included in her sample only abstracts that met the criterion of well-structuredness, which she defined as containing at least the four moves: purpose, method, results and conclusion. Her findings concerning the frequency of linguistic expressions in each move are valuable, but our concern is not just with the well-structured abstract but with abstracts as they are.

In a related study Salager-Meyer (1990b) investigated the extent to which medical abstracts are well-structured. Well-structuredness was this time defined as (1) containing all four moves, as above, (2) having all four moves "in their logical order", i.e. in the standard P M R C sequence and (3) no conceptual overlapping between paragraphs (in abstracts containing more than one paragraph). Only 29 of 47 research report abstracts were considered to be well-structured (62%). This is a high threshold of well-structuredness. Some medical professionals are concerned about the quality of abstracts (e.g. Taddio, 1994). However, to reject so many abstracts considered suitable for publication must bias a description of the genre characteristics.

We looked at 80 medical abstracts to see to what extent they conformed to Weissberg and Buker's specifications. Inevitably this involved a process of categorisation of elements of texts, but we were less interested in trying to establish a set of categories in order to see how reliably these could be applied in analysis (cf. Crookes 1986) than in discovering more about the rhetorical options favoured by writers of medical abstracts.

2. Data and Procedure

We confined our study to "unstructured" abstracts of results-focused papers in the field of medicine. That is, we did not consider conference abstracts or "methods" abstracts, i.e. abstracts presenting a completely new method or machine. We looked at a cross-section of abstracts: 20 from each of the major fields of medicine (clinical medicine, surgery, epidemiology and basic sciences). In case of differences between British and North American journals, in each field we looked at 10 from a British journal and 10 from a North American journal.

We had hoped to include a contrast between abstracts in journals for the general medical reader (such as *The Lancet and the New England Journal of Medicine*) and those in specialist journals but, interestingly, found that the main general medical journals have now converted to structured or semi-structured abstracts, and so were not eligible for this study.

We took the position that abstracts which have been accepted for publication are acceptably formed abstracts. We therefore did not screen out abstracts written by non-native authors.

We downloaded from Medline (an on-line data-base) consecutive runs of abstracts (year 1995) from 8 journals (4 British and 4 North American) held in the University library, so that we could if necessary consult the articles themselves. The journals were:

British	*North American*
British Journal of Clinical Practice	American Journal of Clinical Nutrition
British Journal of Surgery	Journal of Thoracic and Cardiovascular Surgery
Public Health	American Journal of Epidemiology
Biochemical Journal	Archives of Biochemistry and Biophysics

We first separately, then together, analysed the abstracts looking for the principal elements as described in Weissberg and Buker (1990). A few abstracts were immediately discarded as not being results-focused: 2 were methods-focused, 2 were argumentative (about data presentation), and one was a narrative report of a public health investigation. Discarded abstracts were replaced by the next results-focused abstract in the sequence down-loaded from Medline.

References for the abstracts studied are available on request from the authors. They are coded in our report as Clin 1-20 (clinical medicine) Surg 1-20 (surgery). Epi 1-20 (epidemiology) and Bio 1-20 (biochemistry). Because we could find no convincing differences between the British and North American journal abstracts we dropped the UK/US part of the code; however abstracts numbered 1-10 are from British journals and those numbered 11-20 are from North American journals.

We then started on the cyclical process of identifying and defining our categories of analysis. We started by looking for the elements (B) P M R C as defined in Weissberg and Buker (1990). When we had difficulties in applying these categories to our data, these difficulties were analysed. During this process we made frequent reference to Swales and Feak (1994), Zeiger (1991) and the International Committee of Medical Journal Editors (1993).

3. Analysis

We report our analysis under three headings:

analysis of the Purpose element

analysis of the Methods and Results elements

analysis of the Conclusion element.

3.1 Analysis of the Purpose element

One feature of the Weissberg and Buker model which we had found caused confusion in the classroom is the second element they identify, labelled 'P', which is sometimes glossed (1990: 185, 187) as 'purpose'. The following is given as an example of 'P+M = purpose and method of the study':

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> To determine the understandability of individual income-tax booklets, a Reading Ease score was calculated for the 1977 Federal income tax form 1040 and tax forms of the nine south-eastern states. (Weissberg and Buker, 1996: 188)

We assume this corresponds to Zeiger's categories *Question* and *What was done* (1991: 257):

> *[Question]* To determine whether pulmonary venous flow and mitral inflow assessed less invasively, by transesophageal pulsed Doppler echocardiography, accurately estimate mean left atrial pressure, *[What was done]* we prospectively studied 27 consecutive patients undergoing cardiovascular surgery. (Zeiger, 1991: 258)

Syntactic signals of Purpose

In these examples, Purpose (or 'Question') is signalled by a non-finite 'to + INFINITIVE' clause. We found this in 17 of our 80 abstracts.

The main clause, in such cases, is a statement of the means employed to achieve the purpose, i.e. Weissberg and Buker's 'method' ('M') element (Zeiger's *What was done*). 'To' clauses of purpose are syntactically adjuncts, which allows the Purpose element either to precede the Methods statement, or to follow it. As Bhatia points out (1993: 90), placing the purpose clause first conforms to the 'logical' information sequence. The alternative option of fronting the main clause, however, was equally common in our corpus. Reasons for this choice are not always clear, but in cases such as the following it appears that the general topic area (here, breast cancer treatment) is introduced via the main clause, while the 'to' clause indicates the specific aspect in focus:

> A five-year cohort of patients treated 15 - 17 years previously for breast cancer was studied to establish the prevalence of symptoms and objective evidence of circulatory insufficiency in the upper limbs. (Surg 2)

Finally, an alternative (finite) subordinate clause equivalent to the 'to' clauses was used in only one abstract:

> So that changes in production and binding of tumor necrosis- factor-alpha during postpneumonectomy lung growth could be determined, rats underwent left lung resection and were killed 3, 7 or 14 days later. (Surg 11)

Lexical purpose signals: subject noun-phrases in 'purpose sentences'

In 8 further cases, non-finite 'to' clauses occurred as copulative complement in 'identifying be' clauses forming separate 'purpose sentences'. In these cases, the subject noun phrase typically drew on a predictable and very restricted repertoire of 'purpose' lexis (underlined):

> The purpose of this study was to examine the early and late results in 60 patients who underwent 28 (47%) bioprosthetic and 32 (53%) mechanical tricuspid valve replacements. (Surg 16)

> The aim of this study was to examine critically the accuracy of self-reported data in describing the prevalence of overweight in Wales. (Epi 2)

> The objective of this study is to determine the reasons for non-response in both phases of the Shetland Health Study. (Epi 3)

> Our objective was to measure cytochrome oxidase and copper-zinc superoxide dismutase activities in mononuclear cells, neutrophils, and erythrocytes of adolescents with cystic fibrosis, as well as plasma copper and ceruloplasmin. (Clin 11)

There was one example only of an alternative type of 'purpose sentence', in which a 'to' clause occurred as a 'catenative' complement of a lexical verb, *designed*; here it is this verb, rather than subject NP, which carried the semantic load of signalling purpose:

> This study was designed to determine whether intermittent warm aortic crossclamping induces cumulative myocardial stunning or if the myocardium becomes preconditioned after the first episode of ischemia in canine models in vivo. (Surg 12)

Two thirds of these 'purpose sentences' followed initial *background* elements. Interestingly, while purpose sentences of this type were evenly distributed in the three other fields, this way of indicating purpose was not used in any of the abstracts from the biochemistry journals. As we shall see, one of the most distinctive characteristics of biochemical abstracts is the multiplicity of methods and results detail that has to be given. The brevity requirement results in an extremely dense packaging of information, in which the use of a whole sentence for purpose when more economical alternatives exist, is, we suppose, an unaffordable luxury. (Incidentally, we have seen no examples at all of the style recommended by Zeiger for introducing the 'Question' in a separate sentence from 'What was done': *We asked whether ...*)

'Principal activity' and 'scope': Purpose or Method?

The above syntactic and lexical *purpose* signals, which we found in one third (27) of the abstracts, are of course very familiar and unambiguous. There is inconsistency, however, in the way Weissberg and Buker (1990) describe the 'P' element in their scheme: while this is sometimes (pages 185, 187) simply 'purpose', it is alternatively referred to (page 192) as 'principal activity', or (page 186) 'the *principal activity* (or purpose) of the study and its *scope*'. In class we and our students had found this inconsistency somewhat confusing, and we suspected it might point to an area of complexity in the rhetorical options which we hoped our investigation might illuminate.

As we saw above in our discussion of 'to' purpose-clauses, the main clause in such cases describes, often at a somewhat general level, what procedure was adopted to achieve the goal. Such material was analysed, in Weissberg and Buker's terms, as 'Method', though the phrases 'Principal activity ... and Scope', included with Purpose as a single rhetorical element (P), would seem equally appropriate:

> To determine the incidence rate of serious ulcer disease among users and nonusers of nonsteroidal anti-inflammatory drugs (NSAIDs), a retrospective cohort study was done on 103,954 elderly Tennessee Medicaid recipients with 209,068 person-years of follow-up from 1984 to 1986. (Epi 17)

'Scope' seems intended to refer to parameters such as definition of the sample or period of the study, and is regularly expressed in prepositional phrases in sentences which very often contain Purpose elements together with general statements about Method. These phrases function to inform the reader of important aspects of procedure, rather than overall objectives, and is conventionally located in the Methods sections of Research Articles; we argue that they should be analysed as belonging to the *method* element in abstracts, rather than to the same 'P' element as Purpose. In the following examples we have underlined what we consider to be Method, and double-underlined 'scope' elements:

> To test the hypothesis that endogenous opiate peptides selectively influence hedonic response to sweet and high-fat foods, the opiate antagonist naloxone, opiate agonist butorphanol, and a

saline placebo were administered by intravenous infusion to 16 obese and 25 normal-weight women.
(Clin 6)

To examine clinical practice in relation to HRT, especially in patients with hypertension, and to canvass opinions on potential or perceived side-effects, the authors conducted a postal survey of HRT prescribing habits among 285 GPs, physicians and obstetricians in the West Midlands.
(Clin 9)

Experience of such injuries between 1991 and 1994 was reviewed. (Surg 4)

So far we believe we have been able to classify segments of material as either clearly Purpose or clearly Method. However, we found that deciding what did and what did not constitute a statement of 'purpose' was not always so straightforward. Although overt 'purpose' expressions of the types described above were present in only a third of our abstracts, we felt that corresponding parts of the other texts actually performed a very similar - if not identical - function. None of the formal properties listed above, for example, are present in:

This study assesses the feasibility and toxicity of adoptive immunotherapy with tumor infiltrating lymphocytes and recombinant interleukin-2 in 29 patients who underwent resection for stage III non-small-cell lung cancer. (Surg 15)

It would be perverse, however, to argue that this sentence's rhetorical function was in any way different from that of:

The objective of this study was to assess the value of domiciliary consultations carried out by two hospital physicians for care of the elderly, using the resulting admission rates as one of the criteria. (Epi 7)

Moreover, some of the sentences in which the purpose function was 'obliquely' expressed contained information (about the sample) and syntactic characteristics (passive clauses) which are typically associated with statements of Method (see below), rather than Purpose:

The feasibility for placement of endovascular grafts was assessed in 44 consecutive patients admitted for transabdominal AAA repair. (Surg 5)

This raised a difficulty in defining criteria for distinguishing Purpose from Method elements, a boundary we had not expected to be problematic. This is presumably why Weissberg and Buker seem hesitant to apply the term Purpose to the following sentence, which is an example of 'P' - here '*principal activity* (or purpose) of the study and its *scope*' - in one of their sample texts:

As part of an effort to understand the origins of this behaviour pattern, the present study assessed the impact of performance standards on the social behaviour of Type A and Type B children. (Matthews and Segal, 1983: 135, cited in Weissberg and Buker, 1990: 186)

The presence of the verb *assess* in all four of the above examples, of course, helps emphasise their similarity, but is not simply a convenient coincidence. We identified 36 abstract segments which we felt performed the function of indicating purpose but were not signalled by any of the unambiguous syntactic or lexical means; in nine (25%) of these the main verb was either *assess* or its semantic neighbour *evaluate* - verbs which also appeared in five of the 27 'clear' purpose statements.

Lexical signals of Purpose: verbs

In fact, a small set of verbs seem to occur with fairly high frequency to realise the notion of 'purpose' (or 'aim', etc.), rather than to inform about methodological procedures, whether with or without the more overt signals of purpose (*the aim of .. is ... to ..*) referred to above. Six verbs each occurred five times or more in the data either in first sentences or immediately following Background sentences: *examine* (x 9), *assess* (x 8), *study* (x 6), *evaluate* (x 6), *determine* (x 5) *test* (x 5). There were 3 instances of *compare* in what we considered to be Purpose than rather Method contexts, and 3 other verbs occurred twice: *establish*, *identify*, *investigate*. The following were attested only once: *elucidate*, *measure*, *look for*, *explore*.

This group of verbs corresponds roughly to the 'verbal teleological imports' identified by Salager-Meyer (1990a: 113), though she includes verbs such as *review*, *carry out*, *perform*, *undertake* and *send*, which we would argue are used to identify the procedures adopted (i.e. Method), and not the purpose.

It should be noted that the verbs we have identified as signals of Purpose also turn up in sections of the abstracts that are clearly about the methodology rather than the overall objectives:

> A 5-year cohort of patients treated 15-19 years previously for breast cancer was studied to establish the prevalence of symptoms and objective evidence of circulatory insufficiency in the upper limbs. There were 187 survivors of the original cohort of 665. In all, 102 patients were evaluated; 50 had received radiotherapy in addition to surgery. Irradiated and non-irradiated groups were comparable for age, extent of axillary dissection and vascular risk factors. Both arms were assessed for symptoms and examined by Doppler ultrasonographically derived segmental pressures and hyperaemia testing. Doppler ultrasonographic waveform analysis, pulse volume recording and venous outflow air plethysmography. (Surg 2)

The presence of one of these verbs does not of itself invariably signal a Purpose element. However, we would argue that, in initial sentences, or immediately after Background elements, clauses containing these verbs regularly express the goals of the research. Indeed, using a verb from this set appears to be a much more frequent signal of Purpose elements than either the use of nouns such as *purpose* or *aim*, or even the 'to + INFINITIVE' clause: verbs of this type occurred in Purpose elements in nearly three-quarters (59) of the 80 abstracts, but, as we have seen, appear in the more overt structures described above in less than half of these.

We prefer to use the term Purpose to describe the function of this rhetorical element, rather than 'principal activity', which we think blurs the distinction from Method unnecessarily.

The 'purpose' verbs discussed above refer to the aims of the research process, but in a small number of cases, intention is expressed in terms of the communicative purpose of the writers or their texts (cf. Salager's 'ontological imports'; 1990a: 113):

> The present study describes changes (Eps 4)
>
> this paper reports findings on (Eps 8)
>
> This report presents experiences (Clin 5)
>
> We describe the expression of (Bio 1)

The numbers are too small to allow us even a tentative impression of any field-specific preferences for particular 'purpose' lexis, but it is interesting that each of the 'purpose' verbs that recurs in the data is attested in more than one of the four medical fields we looked at. While these verbs may have

a wide currency across fields, a collocation study on a more extensive corpus might well reveal some field-specific lexical patterns that could be presented to specialist learners (cf. Williams 1996).

In other words, it seems to be the case that, in our data, the most reliable signal of introductory elements functioning to explain the purpose of the study was in the lexical choice of a verb denoting the general character or aim of research activity, a small number of which seem to be used very frequently. In a handful of abstracts, a further set of subject NP / verb collocations (e.g. *this paper reports*) referring to the intentions of the reporting process marked essentially the same rhetorical element. Analysing the data in this way, we believe, allows us to be consistent in labelling Weissberg and Buker's 'P' - element 'Purpose', and removes the awkwardness of distinguishing 'principal activity' and 'scope' from 'Method'. We found Purpose elements, identified by these linguistic signals, in a total of 62 of the 80 abstracts examined.

'Fronted claims'

In two biochemical abstracts, generalised knowledge claims were announced early, before Method / Result elements, rather than in the more conventional Conclusion position at the end. This strategy might be seen as an alternative to a Purpose statement, which is thus rhetorically unnecessary. In one case, this option is a natural way of highlighting the continuity between the findings of a previous study by the same research team, presented as Background (We have previously shown...), and those of the present study (We now show...):

> [B] We have previously shown in intact human erythrocytes that both the plasma membrane Ca2+ pump activity and its phosphorylation can be increased by phorbol-12-myristate 13-acetate (PMA), a known stimulator of protein kinase C. These effects were inhibited by high doses of adriamycin (L. C. Wright et al., 1993, Arch. Biochem. Biophys. 306, 277-284). [Fronted claim = P?] We now show that low doses of adriamycin (ADR) (maximum effect at 10 microM for 1-6 min) decrease the amplitude of ... (Bio 12)

In the other case, the abstract begins with a claim that closely echoes the title. The rest of the abstract presents experimental results apparently as generalised knowledge claims, in the present tense throughout (see the Analysis of Results, below). The only hedging is effected through the phrase 'under our experimental conditions' - hardly specific enough to merit Method status:

> Lamb liver phosphogluconate dehydrogenase is inactivated and selectively cleaved during irradiation in the presence of vanadate. Under our experimental conditions, the correlation between the species of vanadate in solution and rates of enzyme inactivation and cleavage indicates tetravanadate as the most likely photosensitizing agent, in agreement with previous data on other proteins. The enzyme is inactivated more rapidly at acidic pH and is partially protected by the coenzyme NADP, but not by the substrate phosphogluconate. Complete inactivation is obtained when only half of the protein is cleaved into smaller peptides. Differences in the pattern of the peptides produced are observed when irradiation is carried out in phosphate rather than in Hepes buffer: in the former instance cleavage results into formation of a main peptide of 47 kDa, while in latter case two additional peptides of 31 and 25 kDa are produced. (Bio 17)

Similarly, one of the Surgical abstracts, dispensing entirely with Methods or (past tense) Results, sets about the business of making knowledge claims and proposing applications, after careful positioning by means of what we take to be a Background 'importance claim':

> Phenotypic manipulation of allograft endothelium to reduce immunogenicity would have a significant impact on transplantation. In this study we have demonstrated that random seeding of a heart allograft with endothelium, of host origin, not only promotes long-term survival, but

reduces the requirement for pharmacologic immunosuppression. We propose that this simple technology could easily be extrapolated to the clinical arena where hypothermia and preservation solutions have allowed allografts to remain ex vivo for extended periods. (Surg 17)

In the absence of explicit signals it can be difficult for the lay reader, at least, to distinguish fronted claims from Background statements. This difficulty is not necessarily related to ignorance of technical language or processes. In the following case, for example, we are unsure whether the underlined sentence is Background, in that the writer is simply restating a known fact (in which case the precise aim of the study seems not to be made explicit), or whether it is a generalisation of the results listed below (fronted claim):

> The success of laparoscopic cholecystectomy has been tarnished by the increased risk of bile duct damage associated with the operation. Many of these injuries can be managed by endoscopic techniques. Experience of such injuries between 1991 and 1994 was reviewed. Twenty-four patients were referred: 11 with injuries to the cystic duct alone, five with complete hepatic duct obstruction and eight with high bile duct leaks. All patients with leaks from the cystic duct were managed successfully endoscopically [...] It is suggested that all suspected injuries after biliary surgery require management by a combination of interventional radiology and endoscopic interventional techniques. Surgery may be required only if there is complete obstruction of the biliary tree. (Surg 4)

Implied purpose

In a small number of the remaining abstracts which lacked either any explicit Purpose statement or fronted claim, the purpose seemed quite clearly inferrable from Background statements, which fell into two categories, *hypotheses* and *gaps*.

Hypotheses

We were initially puzzled by sentences in the early parts of three Surgery abstracts. In each case, the sentence contained the modal *may* (often a Conclusion signal - see below), but occurred before the Method and Result elements. In one case the sentence was preceded by two Background sentences and followed by a Purpose statement signalled by *was evaluated*. The other two were initial sentences, followed by Method statements. On close reading of the rest of each text it was clear that, despite the modal *may*, these were not hedged fronted claims, but references to the hypotheses which the studies were designed to investigate. Note in the example below the lack of modality in the two concluding sentences, which apparently claim confirmation of the hypothesis.

> The complications of open antireflux operations may be reduced by laparoscopic techniques. Fifteen patients of median age 42 (range 16-79) years with gastro-oesophageal reflux underwent laparoscopic fundoplication. Preoperative and postoperative assessment was by clinical scoring, oesophageal pH measurement and manometry. Median (range) operating time was 115 (60-210) mn and hospital stay 3 (1-6) days, with no conversions to open operation and only one minor wound infection. Four patients had occasional reflux symptoms on wound infection. Four patients had occasional reflux symptoms on postoperative assessment at a median of 7 weeks and nine had occasional dysphagia. Median DeMeester symptom scores improved from 4 to 1.5 ($P = 0.001$). There were significant increases in both lower oesophageal sphincter pressure and length. The nocturnal proportion of time at pH < 4 decreased from 9.6 to 0.05 per cent ($P = 0.02$), although the drop in total proportion of time at pH < 4 (10.4 to 2.2 per cent) was not statistically significant ($P = 0.08$). Early objective results of laparoscopic fundoplication show improved symptoms, decreased acid reflux and altered lower sphincter

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function. The procedure combines the benefits of early mobilization and reduced morbidity with the efficacy of the traditional open operation. (Surg 7)

Though no "purpose" verbs are used, it could be argued that the initial *may* sentences perform an equivalent function to Purpose elements in motivating the research processes described, and we are inclined to recognise them as representing an alternative means of signalling Purpose; there is, of course, an obvious relationship between *hypothesis* and (research) *question* - Zeigen's term corresponding to Purpose.

Gaps

In three cases, the aim of the research is implied in the Background element by pointing out a gap in existing knowledge (a frequent strategy for 'creating a research space' in introductions, of course; cf Swales, 1990: 154). In these cases the abstract proceeds from Background to Method / Results, leaving the reader to infer that the aim of the research process described in Method is to fill the gap (underlined in the following example):

> The consumption of n-3 fatty acids from seafood has been related to a lower incidence of coronary artery disease. Adipose tissue composition has served as a biological marker of chronic ingestion of many dietary polyunsaturated fatty acids. However, the incorporation of n-3 fatty acids into the fat depots has not been studied in humans. Daily dietary supplementation with > or = 10 g n-3 fatty acids from fish oil for > 12 mo resulted in significantly greater 20:5n-3, 22:5n-3, and 22:6n-3 concentrations in fatty acids of adipose tissue, and a greater 20: 5n-3 fatty acid content in plasma lipid classes (cholesterol esters, phospholipids, and free fatty acids) of supplemented subjects compared with nonsupplemented control subjects. (Clin 15)

This strategy was represented in one abstract from each of three medical fields: surgical, epidemiological and clinical. In three further cases (from biochemistry and epidemiology), gaps were identified in the Background, but explicitly signalled Purpose statements (underlined) were also included:

> In recent years a number of research projects have reported on the level of alcohol use by young people. The research to date, however, has tended to overlook the ethnic origins of the young people as a factor associated with the level of alcohol use. Against this background, this paper reports findings on the use of alcohol by 15-16-year-olds in Leicestershire with specific reference to ethnic group. (Epi 8)

> Whilst there have been many reported assessments of selective medicals at 5+ school entry, there is a dearth of publications on the value of selected medical reviews at secondary transfer age. It was decided to evaluate this within the South Downs Health Trust. (Epi 9)

> ... However, the mechanism of trans-activation is unknown. The consequences of RAR:RXR binding to the PEPCK RARE were examined using a circular permutation analysis as a first step to explore the possible role of DNA conformational changes in the RA response. (Bio 2)

Note the care with which the preliminary and tentative nature of the biochemical study is stressed in respect of the much wider problem of filling the 'gap'.

The following clinical abstract Background element describes a gap of a different type - in practice rather than in knowledge (though the implication must be that what is really missing is a specific empirical basis for a change in practice):

> As a result of the Seven Countries Study, the Mediterranean diet has been popularized as a healthy diet. Nevertheless, it has not replaced the prudent diet commonly prescribed to

coronary patients. Recently, we completed a secondary, randomized, prospective prevention trial in 605 patients recovering from myocardial infarction in which we compared an adaptation of the Cretan Mediterranean diet with the usual prescribed diet. (Clin 17)

We have analysed the relative clause in the third sentence as Purpose, rather than Method, as, despite following a Method element, it contains one of the verbs (*compare*) which we have argued function in such a context as explicit Purpose signals. This is a borderline case, however.

In claiming to identify implications of purpose, we acknowledge the likelihood that our ignorance of the discipline's goals, values and knowledge base may prevent us making inferential leaps of a magnitude that may seem perfectly feasible from within the discourse community in question. A specialist informant would be needed, for example, to disconfirm our assumption that the purpose of the following study is not made clear to the reader, explicitly or implicitly, at the beginning of the abstract (though we would accept that the Method - retrospective review of medical records - can be inferred by anyone with even a superficial awareness of medical research processes) :

> [B] Primary small-cell cancer of the esophagus is a rare tumor that disseminates early with a uniformly poor prognosis if untreated. [R] Sixteen patients with malignant dysphagia referred to the Thoracic Surgical Unit, City Hospital, Edinburgh, within a 10-year period had a diagnosis of primary small-cell cancer of the esophagus. (Surg 20)

Finally, we should comment on what we mean by *purpose*. We recognise that within the general area of *motivation* one could distinguish *prompts* from *goals*. In this analysis we have assumed that Purpose refers to *goal*, in the sense of the intended outcome of the research process (in Zeiger's terms, the answering of a research 'question'), rather than some pre-existing situation out of which the research has arisen (which we count as Background). Hence we have not considered the underlined phrases in the following examples to be Purpose elements, even though, in the first case, the connection explicitly highlighted between Background and Method is the only motivation provided:

> [B] Wilms' tumor is one of the most common abdominal childhood malignancies. Wilms' tumor rates in Brazil are among the highest in the world. This prompted the Brazilian Wilms' Tumor Study Group [M] to conduct a hospital-based, multicenter, case-control investigation of environmental risk factors for the disease. (Epi 19)

> [B] Because of the potentially serious consequences of myocardial depression in patients undergoing cardiac operation, [P] we examined the effect of vancomycin infusion on cardiac hemodynamics [M] in patients scheduled for cardiac operation. (Surg 17)

> [B] A recent large increase in Caesarean section (CS) in Italy was the initial stimulus for a study [P] to identify risk factors for CS and, if possible, to suggest strategies to counteract the rise. (Epi 6)

The distinction is clearly observed in the latter two examples, where the more specific goals of the studies are also identified as quite separate notions, signalled in ways already discussed ('purpose' verbs *examine* and *identify*, and a 'to' clause, in this case as complement in a noun-phrase). Perhaps a term such as *goal* or *aim* might be a more satisfactory tag.

There remain around 17 abstracts in which the purpose is neither explicitly stated nor retrievable by implication from background information. A co-operative reader familiar enough with disciplinary goals and processes to infer the purpose from the methods or results is apparently assumed. Here, for example, are the beginnings of two of these 'purposeless' abstracts:

> Preoperative laboratory tests were performed on elective ambulant orthopaedic patients (n = 26) on the afternoon after their arrival in hospital and on the next morning before the operation. Significantly lower concentrations of leukocytes, albumin, total protein, platelets, and total calcium were observed ... (Clin 4)

> In the presence of a 100 mM Na+ gradient, transport of L-carnitine into rat renal brush-border-membrane vesicles was linear over 30 s and showed an overshoot at 5 min. The uptake of L-carnitine was clearly less active in the presence of other cations such as Li+, K+, Cs+ or choline... (Bio 7)

Summary of findings re Purpose

Purpose is indicated in an introductory stage in the majority of abstracts, following any Background element. Purpose is indicated in a variety of ways, both explicitly and implicitly.

Explicit purpose elements are normally signalled linguistically, in syntax or lexis, or both.

Lexical signals:

- the use, in appropriate contexts, of one of set of verbs, a few of which form a high-frequency core (*examine, assess, study, evaluate, determine, test*)
- subject noun-phrases such as the aim / purpose of this study
- metatextual subject-verb collocations such as this paper reports.

Syntactic signals:

'to + INFINITIVE' clauses (*to determine*), most commonly as adjuncts in clauses representing Methods elements, (*To determine ... we ...*), or as complements in copulative clauses with Purpose noun-phrases as subject (*The aim of this study was to determine ...*), but sometimes in other constructions.

Fronting generalised knowledge claims is another explicit strategy; present tense verbs are used, but the absence of other signals can make such statements difficult to distinguish from Background for the non-specialist reader.

Implicit indications of Purpose can involve either referring to the research hypothesis (attested only in Surgery abstracts, and signalled by *may*), or identifying a gap in the disciplinary knowledge base; adversative markers (*however*) and negative verbs / lexical items (*not, overlook, unknown*) are typical signals.

3.2 Analysis of the Methods and Results elements

First we give a brief summary of recommendations for the content of the Methods and Results elements of abstracts. Then follows an account of what we found in our sample.

The Council of Biomedical Editors give detailed requirements for the contents of the Methods section of research reports, but for abstracts state simply that, in addition to purpose, main findings and conclusions, information should be given about "basic procedures (selection of study subjects or laboratory animals; observational and analytical methods)" (p 8).

Weissberg & Buker state that the abstract should contain "some information about the methodology used in the study" (p 187), and also point out that, for the sake of brevity and emphasis on results,

abstracts can be reduced to three elements: P&M (Purpose and Method), R (Results) and C (Conclusions) (p. 188).

Zeiger (p 258) advises that the abstract should contain only important details of materials and methods: i.e. the species, population or material, and the experimental approach or protocol (including the independent and dependent variables). But she adds: "However, the abstract is often streamlined in one way: often only the species or the population, their condition, the material and maybe a brief overview of the experimental approach are given in the statement of what was done. The details of what was done - specific independent and dependent variables, doses, methods - are given in the sentences that tell what was found. This organizational strategy avoids repetition." (p.259)

In our sample of 80 abstracts we found examples of:

(i) substantial and separate Methods elements, as might be expected from the recommendations of the Council of Biomedical Editors

We found very few completely distinct Methods elements. Those we did find were usually substantial, summarising the subsections of the Methods sections of the articles abstracted, as in this example:

> [P] So that changes in production and binding of tumor necrosis factor-alpha during postpneumonectomy lung growth could be determined, [M] rats underwent left lung resection and were killed 3, 7, or 14 days later, 1 hour after the injection of 3H-thymidine. Serum was collected, and the lungs were lavaged and perfused in vitro. Lung volumes were measured. Lungs were homogenized, and changes in lung weight, protein content, deoxyribonucleic acid content, deoxyribonucleic acid synthesis, and tyrosine kinase activity of different lobes were recorded. Tumor necrosis factor-alpha content of serum, lavage fluid, and perfusate was measured by an enzyme-linked immunoassay. The binding of tumor necrosis factor-alpha to membrane extracts of lung homogenates was measured by immunoblots. [R] Whereas the cardiac lobe of the remaining right lung demonstrated larger increases in size. (Surg 11)

The language features prescribed by Weissberg & Buker for the Methods section are exemplified here: i.e. chronological ordering, past tense, passive voice.

(ii) minimal Methods elements, often incorporated into Purpose, as described by Weissberg & Buker

Only 4 abstracts had no Methods element; but the great majority of Methods elements were very short, sometimes only one or two words. Each of the examples below, though short, constitutes a complete Methods element. The very short elements probably represent what Weissberg and Buker term 'scope'.

> A prospective audit was performed. (Surg 1)

> Daily dietary supplementation with > or = 10 gm-3 fatty acids from fish oil for > 12 months [R] resulted in .. (Clin 15)

> [P] To establish current practice [M] we circulated a questionnaire to 300 geriatricians ... (Clin 3)

> The clinical findings of 39 cases diagnosed between 1972 and 1991 were reviewed retrospectively.. (Surg 10)

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> A possible association between body iron stores, measured as serum ferritin, and carotid arterial intima-media thickening was investigated in the Atherosclerosis Risk in Communities Study during 1990-1992 using a matched case-control design. (Epi 15)

This selection of examples presents the language features typical of this category of Methods element, namely:

- past passive verbs
- inanimate noun (e.g. *study, report, audit*) with active present verb
- *we* with past verb (denoting research activity)

It is worth noting that in research reports the number of subjects studied may or may not appear in the Methods section but almost always appears at the start of the Results section; regardless of whether it was given beforehand. In all of our sample of abstracts the number of subjects studied appeared only once, and always in the Methods element.

(iii) one or two statements of Methods embedded, usually subsententially, at relevant points in the Results element, as described by Zeiger

In research reports, the procedures used are identified and described if necessary in the Methods section. Reference is then made to them again at the relevant points in the Results section. We found a few instances of this in the abstracts: e.g.:

> [M] Mean differences between self-reported and measured weight and height were used as indicators of bias, and the accuracy of BMI and the prevalence of overweight based on this data were analysed.....[R]....The calculation of body mass index resulted in .. (Epi 2)

but double reference to a procedure was not common, presumably because of constraints of brevity. However, the single reference often occurred in Results rather than in Methods. This was particularly true of reference to statistical procedures.

The statistical procedure can be implied:

> The relative risk (RR) for those drinking one glass of milk per day was similarly low (RR = 1.2; 95 percent confidence interval (CI) 0.7-2.0) .....(Epi 16)

or described in a complete sentence

> Stepwise logistic regression analysis was used to find independent determinants for this clustering from a set of socioeconomic, demographic, and behavioral (type A components) determinants. (Epi 13)

or (most commonly) it was in subject position:

> Logistic regression analysis showed that women who drank two glasses of milk per day had the lowest risk .. (Epi 16)
>
> Multivariate analysis showed no correlation between the factor of incomplete resection and survival. (Surg 15)

We also found 2 abstracts where the results were in two subsections, with a short reference to method (underlined in the example below) before the second section: e.g.:

> [R1]...The age-adjusted mortality rates (per 100,000 person-years) for the four cohorts were 760 (Japan), 158 (Israel), 408 (Allegheny County), and 250 (Finland). By using the mortality data from Allegheny County, Pennsylvania, to extrapolate to the US IDDM mortality experience, the authors estimated [R2] 2,396 deaths .. (Epi 12)

It could be argued that this is a short sequence of elements MRMR, rather than embedding (see below).

(iv) statements of Methods embedded throughout the Results element, in keeping with Zeiger's recommendation

One of our more unexpected findings was that many of the biochemistry abstracts did not follow the textbook pattern of Method element followed by Result element, as described by Swales (1990) and as recommended by Weissberg & Buker and the International Committee of Medical Journal Editors. Instead the abstracts report a series of findings elicited by different procedures. This type of information structure is in fact reported by Zeiger:

> "However, the abstract is often streamlined in one way: [...] The details of what was done - specific independent and dependent variables, doses, methods - are given in the sentences that tell what was found. This organizational strategy avoids repetition ... (Zeiger: 1991, p 259)

The following example (with Method elements underlined) shows how interlaced the Method and Result elements are:

> The presence of cytochrome P450 (P450) and associated monooxygenase activities were estimated in isolated rat brain mitochondria and compared with the corresponding activities in microsomes. Total P450 content in brain mitochondria from naive rats was twice that of the corresponding microsomal level. The ability of brain mitochondria to metabolize the potent carcinogen N-nitrosodimethylamine was more than twofold that of the corresponding microsomal activity, while the 7-ethoxycoumarin-O-deethylase activity was significantly lower in mitochondria. Immunoblot experiments using antisera to purified rat liver microsomal P450s, namely P450 (2B1/2B2), P4501A1, and P4502E1, and purified phenobarbital-inducible rat brain P450, revealed the presence of immunoreactive bands in isolated brain mitochondria. These various antibodies to P450 inhibited the brain mitochondrial monooxygenase activities to significant, though varying extent. The addition of antiserum to microsomal NADPH cytochrome P450 reductase did not affect the mitochondrial P450 associated monooxygenase activities, although it completely inhibited the corresponding microsomal activities. Chronic ethanol administration resulted in twofold induction of total P450 content and the monooxygenase activities known to be mediated by P4502E1, such as N-nitrosodimethylamine-N-demethylase and p-nitrophenol hydroxylase in brain mitochondria. Pretreatment of animals with phenobarbital resulted in the induction of aminopyrine N-demethylase activity in brain mitochondria. (Bio 19)

This pattern occurred in as many as 14 of the 20 biochemistry abstracts, but not at all in the abstracts from clinical medicine, surgery and epidemiology (apart from the 2 instances of MRMR patterns in epidemiology: see above). We speculate that this difference reflects a difference between the research process in biochemistry and the other three fields. Consultation with a specialist informant will be needed to confirm or disconfirm this.

It is worth noting here that the biochemistry abstracts differed from others also in that 3 of the 20 were in present tense throughout. None of the rest of the sample used present tense throughout. The advice in Weissberg and Buker is to use past tense for Methods and Results. Swales and Feak, however, point out the present tense phenomenon, commenting that it is "more likely to occur in

physical sciences such as physics, chemistry and astrophysics and less likely to occur in the social sciences" (p 213).

Summary of findings re Methods and Results in abstracts

1 Extended (i.e. more than a sentence) and discrete sections on Methods occurred but were rare.

2 Statistical procedures were not given in Methods, but named or implied at relevant points in the Results.

3 Biochemistry abstracts tended not to have classic Methods and Results elements, but to present sequences of experimental procedures and findings.

4 Verbs in Methods and Results were all past tense except in 3 abstracts (biochemistry) where present tense was used throughout.

3.3 Analysis of the Conclusion element

Instructions in the *Uniform Requirements for Manuscripts Submitted to Biomedical Journals* (International Committee of Medical Journal Editors, 1993) are specific about the contents of Methods and Results elements in abstracts, but about the Conclusion the advice is simply to state "the principal conclusions" (p 8). Weissberg and Buker's model similarly specifies "a statement of conclusion or recommendation" (p 186), though more can be inferred from their instruction to use the "present tense/tentative verbs/modal auxiliaries" (p192).

In Zeiger's slightly different model of the abstract, *Question*, *What was done* and *What was found* are followed by *Answer*. She emphasises the importance of making sure that the answer answers the question asked, and adds: "If part or all of the importance of your paper is the implication of the answer or a speculation based on the answer, include a sentence stating the implication or speculation at the end of the abstract" (p 258).

We did not ask "What are Results?" but we did find ourselves asking "What is a Conclusion?" It clearly means more than the sentence which is last. We used a crude working definition: a generalisation after a list of findings, which may involve a summary of findings and/or implications, in terms of support for a hypothesis and/or indications for future research or clinical practice. We also kept in mind Zeiger's view that the conclusion should provide an answer to the research question.

We then scanned through our sample looking for conclusions. While analysing we noticed we were responding to the following language signals:

- explicit announcements of conclusion *it is concluded that*
- signals of summary like *these data show*
- signals of implication and recommendation - *implications, should*
- logical connectors like *thus, therefore, hence*
- change from past tense (reporting results) to present tense (knowledge claims)
- modification of the generality of the knowledge claim, through modals like *may*; adjectives and adverbs like *mainly, probable*, and verbs like *suggest, appear*
- value nouns; adjectives and adverbs, like *benefit, important, efficiently, useful*

Conclusions were typically signalled by more than one of these. For example the following conclusion contains an explicit announcement of conclusion, change from past tense in Results to present, a logical connector (*thus*), a modified knowledge claim (*it appears*), and a value adverb (*efficiently*):

> [R] higher plasma concentrations of antioxidant vitamins C and E were observed. [C] We conclude that a Cretan Mediterranean diet adapted to a Western population protected against coronary heart disease much more efficiently than did the prudent diet. Thus, it appears that the favorable life expectancy of the Cretans could be largely due to their diet. (Clin 17)

and a similar array of language features can be seen in these two examples:

> [R] ... and none of the patients with incomplete resection (12 cases) had relapse within the thorax. [C] The present experience demonstrates that adoptive immunotherapy may be applied with safety in patients operated on for stage III non-small-cell lung cancer and suggests that it can be useful, notably in patients with locally advanced disease. (Surg 15)

> [R] ... affected DNA ring closure in a phase-sensitive, RA-insensitive, manner. [C] Taken together, these observations support the idea that RAR/RXR heterodimers distort the structure of the PEPCK RARE, at least in part, by altering DNA flexibility. The conformational change in the PEPCK RARE upon RAR/RXR binding has implications for how RAR/RXR heterodimers recognize various RARE structures. (Bio 2)

On first inspection we confidently identified conclusions in 55 of the 80 abstracts.

We also identified 2 abstracts as having no conclusion. Both ended with results, not summarised and with no general knowledge claim. It is worth noting that neither of these abstracts started with a statement of purpose, and so there was no clear answer to a research question. One of these abstracts is given below in full:

> Brain tissue blood flow was measured precisely by the colored microsphere method during retrograde cerebral perfusion in 10 normothermic mongrel dogs. The average tissue blood flow rates to the cerebral cortex, cerebral medulla, brain stem, cerebellum, and spinal cord during retrograde cerebral perfusion at 25 mm Hg of external jugular venous pressure were 10.5 +/- 10.3, 4.2 +/- 4.6, 11.1 +/- 9.8, 12.3 +/- 8.6, and 9.1 +/- 5.8 ml/min per 100 gm, respectively. The brain was perfused wholly by retrograde cerebral perfusion without lateralization. Total cerebral blood flow was calculated as the sum total rates of blood flow to each area. Total cerebral blood flow during retrograde cerebral perfusion at 25 mm Hg was 7.8 +/- 4.4 ml/min, which represented 3.5% +/- 1.9% of whole body blood flow and one third of the total cerebral blood flow (28.0 +/- 4.2 ml/min) during cardiopulmonary bypass at a flow rate of 1000 ml/min. Oxygen consumption and carbon dioxide elimination by the total cerebrum during retrograde cerebral perfusion at 25 mm Hg were 0.54 +/- 0.23 ml/min and 34 +/- 15 mumol/min, respectively, or 8.6% +/- 3.6% and 7.0% +/- 3.1% of the corresponding whole body value and represented about one third of that measured during cardiopulmonary bypass (1.21 +/- 0.39 ml/min and 96 +/- 15 mumol/min). Total cerebral blood flow, total cerebral oxygen consumption, and carbon dioxide elimination increased as the external jugular venous pressure increased from 15 to 25 mm Hg; however, no further increase occurred once the external jugular venous pressure exceeded 25 mm Hg. (Surg 18)

We think that these 2 abstracts are defective, in spite of having passed through editorial screening to publication. (See Salager-Meyer (1990b) and Taddio et al. (1994) for studies of abstracts published with missing elements.)

During this stage of the analysis we also remarked that 10 further abstracts, although lacking final generalisations, appeared to be informationally complete. They stated a research question (or purpose) and then answered it by stating the results, thus fulfilling the requirements proposed by Zeiger. That is, a summary of results can be understood as a conclusion, providing that the results do not need interpreting for the question to be answered. We were therefore reluctant to classify these with the 2 abstracts without conclusions. An example follows:

> The use of warfarin and aspirin for the primary prevention of stroke in elderly patients with atrial fibrillation (AF) is controversial. To establish current practice we circulated a questionnaire to 300 geriatricians (G) and 300 cardiologists (C). The response rates were 47% G and 51% C. Most physicians prescribed warfarin in AF associated with mitral stenosis (G vs C, 86% vs 89%, NS). Cardiologists were more likely to prescribe warfarin in AF associated with dilated cardiomyopathy (G vs C, 52% vs 86%, $P < 0.01$). A minority would prescribe warfarin in aortic valve disease and AF (G vs C, 37% vs 24%, $P < 0.05$) and lone AF (G vs C, 10% vs 26%, $P < 0.01$). Aspirin was favoured in aortic valve disease and lone AF. The cardiologists were less reluctant to use warfarin in the young and more likely to electrically cardiovert the young with chronic AF. (Clin 3)

Admittedly this abstract lacks any statement of implication or recommendation. But we had already accepted abstracts as having conclusions when the conclusion was no more than a generalising summary of results. Is a summary necessary, we asked, when the statements of results provide as clear an answer to the research question as they do in this example? For us, only one of these 10 abstracts would have been clearer with a summary - and that may be because of our lack of subject knowledge. That one abstract was added hesitantly to the "no-conclusion" category. The remaining 9 were categorised as being informationally complete but lacking a rhetorical conclusion. We recognise, though, that there are two strong arguments against our claim that abstracts can be informationally complete without a rhetorical conclusion. The first is that, quite apart from textbook recommendations, the professional literature (e.g. International Committee of Medical Journal Editors (1993); Taddio (1994)) consistently requires a conclusion. The second is that there appears to be a discourse community convention that abstracts need a conclusion to achieve rhetorical completeness. Interestingly, we noted that out of the 9 abstracts presently categorised as informationally complete but without conclusions 4 ended with a non-numerical result, as if echoing the rhetoric of conclusion without fulfilling a real generalising or summarising function. For example:

> A 4-week study involving 354 patients with the symptoms of gastro-oesophageal reflux disease was conducted to assess the effect of ranitidine (as effervescent tablets) on their relief and quality of life. All patients received 150 mg bd for 2 weeks, with those responding to treatment continuing on the same dosage for a further 2-week period and 'non-responders' having the dosage increased to 150 mg qds for a further 2 weeks. Quality of life and symptom assessments were carried out at 0, 2 and 4 weeks. Two weeks' treatment with ranitidine 150 mg bd was effective at controlling the GORD symptoms in 78% of patients. A 4-week treatment with either 150 mg bd or qds controlled the symptoms in 85% of patients. All patients had significant improvements in all dimensions of their quality of life over the study period. (Clin 6)

Turning next to the "difficult cases" still unclassified, we looked more carefully at our checklist of language signals, and carried out a frequency count across the whole sample of 80. The results are given below.

Category of language signal	Frequency of occurrence
change from past tense to present tense/modal	58

anaphoric noun phrases (*these data*)	43
lexical verbs making modified claims (e.g. *suggest, appear*)	*31/41
lexical verbs making unmodified claims (e.g. *show, demonstrate*)	*25/37
modal auxiliary verbs making modified claims (e.g. *may, can*)	*19/24
value nouns, adjectives and adverbs (e.g. *important, useful*)	16
recommendations (only *should, need*)	12
explicit announcement of conclusion (e.g. *we conclude*)	7
logical connectors (only *thus, therefore, hence*)	*4/5

* the first figure denotes the number of occurrences in the final sentences; the second figure includes occurrences throughout an MRMR or sequenced MR abstract, where results may be commented on separately as they are listed.

We were surprised to note the low number of logical connectors, and also the preference for modification by lexical verb over modal auxiliary. But for us the most striking finding was the 58 occurrences of change from past to present tense/modality. All 55 abstracts that we had identified as definitely having conclusions evidenced this tense change. We had thought we were responding to a complexity of factors - and perhaps indeed we were - but the tense change signal appears to be what most influenced our perceptions.

With this insight we looked again at the remaining unclassified 13 "difficult cases". Four of these were judged now to have conclusions:

The first was missed because of the unorthodox use of present perfect tense:

> [R] the declining prevalence was found in those with a vocational education only and an existing educational difference in smoking behaviours was enhanced. [C] The decline in smoking in Denmark in the last decade has been associated with a narrowed gender difference and widened social difference. Knowledge of the health consequences of smoking has increased independently of these changes in smoking behaviour. (Epi 4)

The second, we argue, contains a conclusion on the strength of the phrase *remaining to be addressed*:

> [R] showed no evident change with 9.5% of children selected from 2729 in 1992 and 9.6% selected from 2473 in 1993. However, analysis of individual schools showed significant changes [C] which illustrated the improvements achieved and the areas of weakness remaining to be addressed. (Epi 9)

The third and fourth were held to be borderline on first inspection because of the limiting effect of the past tense. Now we argue that this is outweighed by the other signals of generalisation:

> [R] significantly correlated with corresponding concentrations of fatty acids in adipose tissue. [C] These findings indicate that the long-term ingestion of large amounts of n-3 fatty acids in humans resulted in their incorporation into the adipose tissue fatty acids. Incorporation of the fatty acids into adipose tissue warrants consideration for use in clinical studies requiring precise documentation of long-term n-3 fatty acid consumption. (Clin 15)

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[R] whereas no group difference in the serum concentrations of thiobarbituric acid-reactive substances was observed. [C] Thus, no adverse metabolic effects of long-term fish-oil supplementation assumed to be of clinical importance were seen. (Clin 19)

Of the remaining 9 "difficult cases" one had an MRMR structure, with each subsection of R starting with a claim in past tense, followed by evidence, e.g.:

For trisomic loss, later data did not support prior observations. Associations between trisomy and past or current smoking did not vary significantly with age. (Epi 18)

Another presented a list of results, with the last as a present tense claim:

The natural variation among inbred strains of mice was used to elucidate the genetic factors underlying the responsiveness to high-fat and high-cholesterol diets. The nine strains examined are the progenitors of recombinant inbred strain sets: C57BL/6J, C57L/J, SWR/J, SJL/J, SM/J, A/J, AKR/J, C3H/HeJ, and DBA/2J. Plasma lipids, liver lipids, the prevalence of cholesterol gallstones, and the size of aortic fatty streak lesions were examined after 18 wk of consumption of the diet containing 15% fat and 1% cholesterol. The variation in aortic lesions found among inbred strains provided the basis for several additional studies that demonstrated the existence of eight genes affecting atherosclerosis. These genes, named Ath1 to Ath8, are briefly described. The genetic analysis of variation in gallstone formation demonstrated that more than one gene affects this phenotype. (Clin 13)

Similarly, another had signals of conclusion in the final sentence but the sentence summarised only the last of a list of results:

[R] Red blood cell ($r = -0.49$, $P < 0.05$) and plasma ($r = -0.42$, $P = 0.08$) folate concentrations were negatively correlated with milk zinc concentrations. Mean red blood cell folate content declined between 4 and 12 wk PP among PL (31%) and FF (34%) subjects ($P < 0.05$) but not among SL subjects. Hence, 300 micrograms folic acid/d was sufficient to prevent a decline in blood folate values of these adolescents PP. (Clin 14)

It is possible that the last two examples are further illustrations of the influence of rhetorical conventions.

The remaining 6 "difficult cases" were all from the field of biochemistry. Three of these used present tense throughout (Bio 14, 17, 18). For example, the abstract (Bio 17) quoted on page [10] was all knowledge claims. A fourth abstract (Bio 10) similarly consisted of a sequence of claims, but with mixed tenses and comment. Swales & Feak (1994) point out that although past tense is most commonly used for the presentation of results in abstracts, present tense abstracts do occur, and suggest that present tenses are most likely to be found in physics and chemistry. Our findings support their suggestion.

The remaining two biochemistry abstracts were too technical for us to be sure of the functions of sentences, in spite of signals. Consultation with a subject specialist would clarify the functions of present tense sentences in these abstracts. It would also be interesting to ask for the judgement of subject specialists as to the adequacy of the abstracts with no conclusion (categories B and C below).

Summary of findings re Conclusions in abstracts

Our analysis so far points to the following categories:

A	Clearly marked conclusion, offering a generalisation of some sort and an answer to the research question; and/or implications	59 abstracts
B	No conclusion in terms of generalisation and/or implications, but the listed results answer the stated research question	10 or 9 abstracts
C	No conclusion i.e. no generalisation and no answer to a research question probably unsatisfactory abstracts	2 or 3 abstracts
D	"difficult cases"	9 abstracts
	(present tense claims throughout)	(3)
	(method, results, claims and implications interwoven)	(2)
	(generalisation of final result only)	(2)
	(incomprehensible to us)	(2)

4. Comment

The majority of the abstracts in our sample were found to be in accordance with the Weissberg and Buker model (B) P M C, but a considerable number differed. The most frequent difference was that one or more elements were missing. This raises the question, which we could not confidently answer, of whether the model should be adapted or whether the abstracts are defective; some alternative rhetorical strategies seem effective. Subject specialist judgements would be interesting on the well-formedness of these abstracts, particularly with regard to the adequacy of statements of purpose and meaning of findings.

A second difference was the tendency of biochemistry abstracts (14/20) to have a different MR structure from the model and the rest of the sample. This difference has important implications for ESP materials, suggesting that it cannot be assumed that the Weissberg and Buker model will be appropriate for all fields.

Weissberg and Buker's materials are less satisfactory with regard to the language specifications, as opposed to structure and function. In general their prescriptions about verb tenses hold true, but the range of linguistic options is very limited, and therefore limiting, particularly with regard to lexical signals. The book could be supplemented with further abstracts for students to study and evaluate. If the supplementary abstracts are drawn from the students' own fields then the problem of possible differences across fields would also be dealt with.

Swales (1981) introduced the concept of the rhetorical *move* as a broad analytical unit for the study of genres. The *move* works well in text genres which one can relatively easily segment into sequential chunks of discourse, but we found that the brevity imperative results in a tightness of linguistic packaging in which chunks are embedded in others. A broad-brush approach to segmentation is too crude.

At an early stage we abandoned an attempt to establish a minimal syntactic unit of analysis on which we might confer *move* status. Crookes (1996) acknowledges that the sentence, his chosen unit, conceals important shifts in rhetorical focus, and it was quickly clear to us that we needed to operate

with smaller segments. We tried the clause (finite or non-finite), but found this, too, to be unsuitable. Method, for example, seems to be perceived as a discrete informational constituent, but is regularly expressed subclausally, in prepositional phrases or noun phrases combining in clausal structures with Purpose or Method expressions. Chafe's discoursal category of *idea units* seemed attractive (Chafe 1980), but we found these difficult to identify reliably. This may be because Chafe's primary criteria are prosodic, and we were working in a written medium. In the end, we decided to abandon the search for a precisely defined principle of segmentation which was appropriate for our purpose, and opted for the deliberate vagueness of Weissberg and Buker's preferred term, *element*.

The process of analysis was very subjective. We were in good agreement with each other in interpretation but felt insecure about the basis of our judgements. Readers who have had the patience to study our example texts will realise that for applied linguists these are grindingly difficult texts to understand. We also chose not to work with fixed categories but instead to go through a cyclic process of defining, identifying and redefining in order to establish categories that were useful for the description of our data. During this process we found ourselves swinging between the criteria of information structure and language signals. The complex interaction between information structure and language signals is properly central to genre studies, but we were not able to clarify the relation between the two in the process of analysis. Because we are not members of the discourse community and do not share its knowledge, it is possible that we have been over-reliant on language signals.

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